# The State of Software Development in India

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*Recently software development costs in this country have skyrocketed and qualified talent has been difficult to find. An increasing number of organizations have been exploring ways to get developmental help from other countries. This article is the result of the author's participation in a Strategic Technology Tour of India and will try to shed some light on the status of the software industry in that country and how it can benefit the software development needs in the United States.*

Micro Electronics and Computer Technology Corporation (MCC) organized a Strategic Technology Tour (STT) of India. The reasons for the tour were twofold:

1. To get an understanding of the state of software development in India.
2. To understand opportunities for partnering with Indian organizations.

Several North American and European companies were represented on the STT team, as was the Center for Information Systems Engineering, Carnegie Mellon University. This author was one of the representatives of that university.

During this two-week tour, the STT team made site visits to Indian-owned software firms, Indian software development centers of North American firms, and joint ventures. Also, team members met with several governmental and quasi-governmental organizations related to the Indian software industry, and participated in four industry roundtables organized by the Software Technology Parks of India (STPI).

## Government Involvement

In recent years, the government of India has strongly encouraged the development and export of software by Indian firms. The STPI is a quasi-public organization established by the government of India, Department of Electronics. It plays an important part in providing the infrastructure for the development of the Indian software industry.

STPI provides physical facilities by making office space available on favorable terms to software firms, which conduct a high proportion of export work. In addition, STPI has created an innovative data communications network that employs microwave communications between software development facilities and a local STPI node, and satellite links for long-haul segments (including international). Also, software firms that function under the STPI are able to import computer and telecommunications gear for use in their development centers without paying import duty.

Additionally, state governments are strongly involved in software development activities. The state of Andhra Pradesh for example, is very actively working on establishing state-of-the-art facilities and infrastructures in Hyderabad, the capital. The STT team visited with the chief minister of Hyderabad, who firmly believes in the important role information technology would play in the development of his state as well as the entire country.

## Technical Capabilities and Methods

Indian software firms are leaders in software quality and managing quality processes, although they are typically followers in the software development technology domain. The firms the team visited focus on using current-generation tools to maintain and develop software for paying customers, rather than on developing the next generation of tools and techniques.

Most Indian software firms use a variety of software development models – waterfall, spiral, and rapid application development – with the choice driven by the requirements of a particular project such as maintenance or development. Several Indian firms have developed impressive in-house systems for software development support and project management. Most firms have their process documents and manuals on the Intranet or other in-house information system for easy online access.

Contrary to our initial assumptions, many Indian companies are no longer satisfied with "just writing code." Most companies the team visited expressed an interest in moving up the value chain in their relationship with their Western customers. Some companies are already exhibiting increasing capabilities in architecture and whole systems design, systems integration, and systems migration. Favored application domains include banking and finance, electronic commerce, health-care information systems, electronic commerce, and telecommunications and network management.

The STT team, overall, was very impressed with the competence of Indian companies. Most of the companies who had undergone a formal Capability Maturity Model®-based assessment were at a Level 3 or 4. The team had the general impression that even the companies that had not gone through a formal assessment were at a high maturity level. It is to be noted that unlike U.S. companies, Indian companies are reluctant to go through an assessment until they are absolutely sure that they will be assessed at least a Level 3.

## Education and Training

It is estimated that India has about 150,000 information technology (IT) professionals. This number can be broken down into roughly 60,000 software engineers, 15,000 graduates in computer science and related disciplines, and 75,000 from other engineering disciplines. In contrast to the *wimp factor* sometimes attached to it in the United States, an IT career is highly desirable in India, and currently has earning power even greater than physicians.

A key piece of infrastructure for the Indian software industry is the country's

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educational system. There are some 210 universities in operation in India. These universities currently graduate more than 25,000 students in computer science and related disciplines each year, and initiatives are under way to double this number. The Indian Institutes of Technology and the Indian Institute of Science are widely acknowledged to be excellent. The Indian Institutes of Technology have strict admissions criteria, and attract the very best of students. As a result, their graduates are much coveted by the top software companies such as Hughes Software Systems, Citicorp Information Technology Industries, Motorola India Electronics, Infosys, Wipro Systems, and HCL Consulting.

Despite many new entrants to the software engineering ranks, India is now faced with a labor shortage with regard to the highly talented professionals who leave to seek employment in the United States and other Western countries.

Training after hiring is also a high priority for Indian software organizations. Across the sites the team visited, each technical employee receives between 1.5 and 3.5 weeks of training each year. One company has three months of classroom training and an additional three months of on-the-job training for each new employee. Areas emphasized for training included information system technologies, application domains, design/development processes, quality assurance methods, and tools. The most pressing skill needed in the industry is for project managers, and most companies are developing programs to train (some to certify as well) their promising technical personnel for those positions. Several companies have their own training institutes to develop and manage the delivery of the training material.

## Managing Human Resources

Companies used various recruitment methods, including newspaper advertisements, working with placement consultants, and recruiting on university and college campuses (quoted as the main source). Some companies claimed to have very stringent recruitment criteria. Only top of the class were invited for the initial interviews and the companies also administered several internal tests before the hiring decisions were made. Most companies preferred graduates with computer science degrees. One company hired graduates from any engineering discipline, but con ducted a mandatory 12-week initial training before commencing regular work.

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Even though highly qualified talent is more readily available in India than in the United States, retention seems to be a large issue. The attrition rate quoted varied between 12 percent to 30 percent. Main reasons cited were the IT professionals' desire to emigrate to the United States, or their being hired away by other large companies. Indian software engineers can now frequently find positions in North America or Europe with the employer willing to make arrangements for a work visa.

Indian software companies are seeking to counter this problem by creating opportunities for young software engineers to work abroad, and by wooing middle-aged technical managers who may want to return to India to raise their children. Nevertheless, this brain drain is so severe that several of the firms we met with avoid recruiting from the six Indian Institutes of Technology because as many as 95 percent of their graduates go abroad for jobs or further education.

The most successful companies seem to be those that have been the most innovative in managing this issue. These companies are stepping up their attention to employee quality-of-life issues such as choice of assignments and locations, working hours, and training. Several tactics used to retain employees include free or subsidized housing, stock options, opportunities to work abroad, free or subsidized meals, assistance in buying cars, and free transportation. Providing job satisfaction was also mentioned as a key retention factor.

The STT team was consistently impressed with the focused attention paid to retention issues by the human resources departments of most Indian companies. Several attribute this focus to their use of formal models. One uses the Software Engineering Institute's People Capability Maturity Model (P-CMM), while another uses its own organization maturity model. Like the Software Capability Maturity Model (SW-CMM), the P-CMM helps an organization self-assess its capability in key process areas associated with each of five levels of maturity, and guides an organization in improving its level of maturity.

## Project Management

The Indian software industry's approach to managing IT projects has evolved significantly during the past decade. It is rooted in the industry's experience with customers in North America and reflects a number of standard U.S. approaches to project management. Under the influence of ISO 9000 and the SW-CMM, their approach has evolved to be more focused on quantitative process management and in-process quality. Today, people, process, and quality considerations primarily drive it.

The project manager is involved with the project planning exercise right from the beginning. The projects are controlled tightly with the help of separate execution plans, quality plans, and configuration management plans. They assess status by using quantitative data (metrics) collected with in-house developed tools. Many companies use a process guide containing the entry criteria, task identification, verification methods, and exit criteria for each process element to plan and manage their projects. Typically, the guides contain about 20 to 25 process elements (six to eight management, 10 to 12 development, and four to six support) and are available on-line to all their employees.

## Global Competitiveness

Some companies such as Digital and Sun Microsystems have formed partnerships with North American and European companies in joint software development.

Other companies have dedicated marketing organizations overseas. Even though the software development companies currently enjoy a pricing advantage (developmental costs in India are about one-third of those in the United States), they expect to lose that advantage in the next three to five years and at that time, they expect to compete solely on the basis of quality.

## Conclusion

Even though the STT team was aware of increased software development activity in India, some members had assumed that most of it consisted of writing code for systems designed by North American and European companies. It was also assumed that developmental costs in India were considerably cheaper and therefore desirable to North American and European companies. As mentioned earlier though, this price advantage is likely to dwindle as the premier software companies, which take pride in their products and processes, hope to compete strictly on the basis of quality.

This writer's general observation was that the work ethic in the organizations the team visited in India was very high. Even though some of the organizations we visited had not gone through a CMM-based assessment as yet, they were stringently following all of the key processes in anticipation of reaching Level 3 or 4. Unlike the individualistic culture in many U.S. organizations, which resists following processes, Indian companies expect processes to be followed and there are no questions asked. Also, a high value is placed on collecting and tracking metrics and project management.

At the conclusion of the tour, the STT team certainly had a better understanding and appreciation for software development capabilities in India. Some of the companies on the tour that already had operations in India have greatly expanded their investment. Other companies such as American Express and Oracle have opened up new operations. According to the Software Technology Parks of India, which has 19 centers throughout the country, software export has shown an increase of 95 percent during the past five years.

Indian software companies place great value in understanding and meeting their customers' requirements and providing the highest quality products and services. Language is not a barrier since English is the language of business in India. The United States has much to gain in associating with Indian companies in terms of working with a highly disciplined workforce with a view toward obtaining timely, cost-effective software of the highest quality.◆

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## About the Author

**Chellam Embar** is the principal of ChangeShop, Inc., a consulting firm that offers services in Technology Introduction and Transition. He is also a visiting scientist with the Software Engineering Institute, of Carnegie Mellon University. Embar has more than 20 years of change management experience with technology intensive organizations in private industry, military, government, and non-profit sectors. He has helped organizations in the areas of process improvement, transition and change management, strategic visioning, culture change and values identification, productivity, profitability, and quality improvement efforts, employee involvement programs, communication skills training, team building, conflict resolution, performance management, management development, and career development. Embar recently participated in a Strategic Technology Tour of India, and keeps current with the state software development in that country. Embar received an MA degree in Human Development from Governors State University, University Park, Illinois. He is the author of several books and publications.

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